
XV. *Observations on the Tracheæ of Birds; with Descriptions and Representations of several not hitherto figured. By William Yarrell, Esq., F.L.S.*

Read February 6, 1827.

THE various qualities and powers of voice exhibited by birds in general, and the diversity of structure known to exist in the tracheæ or windpipes of different species in some particular families, have justly excited the attention and remarks of several writers. Dr. Latham, in the 4th volume of the *Transactions* of this Society, has furnished descriptions and illustrations of the peculiarities of this part in some of those species most remarkable for their deviation from the common form; and to his paper I shall occasionally take the liberty to refer.

To other sources ornithologists are indebted for delineations not included in the essay before mentioned: and the present communication, accompanied by drawings of several tracheæ not hitherto figured, will, I trust, be considered an acceptable addition on this interesting subject.

The peculiarities in the form, as well as in the composition, of the several parts of the windpipes of birds, having already been described under the different names of the glottis, or superior larynx; the tube; the bone of divarication, with its cross-bone forming the lower end of the tube; and lastly, the bronchia, by which the bone of divarication is connected with the lungs;—I shall proceed at once to the descriptions of those new forms of tracheæ which are the subject of the present communication.

The

The Crested Pintado of Africa, the *Numida cristata* of Pallas, described and figured in Dr. Latham's *General Synopsis*, vol. iv. p. 638, and in his *General History*, vol. viii. p. 148, exhibits an extraordinary structure, to which I shall first advert. That part of the *os furcula*, or merrythought as it is more commonly called, which in our common Guinea Fowl consists of a single flat blade descending from the apex or junction of the two branches, is in this bird double, one side appearing to extend from each branch; it is also somewhat circular, and united at the edges throughout the greater part of the circumference, forming a socket or pouch. The trachea, quitting the neck of the bird at the lower curve of the cervical vertebræ, passes downward between the branches of the furcula, enters the pouch at the lower part of the orifice, traverses the inner surface, and issuing from the upper part, rises with a circular sweep, upward and forward to the projecting anterior portion of the sternum, over which it turns backward to pass into the body; guided in its course by two semi-transparent membranes, stretching from this projection of the sternum to the head of each clavicle.

If a line be drawn from the commencement of the trachea, as shown in the figure, to the bronchia, passing between the scapulæ, it will describe the situation of the trachea in our common domestic Guinea Fowl, and the variation of the crested bird will appear the more extraordinary by comparison.

For the opportunity of figuring this singular structure, I am indebted to the liberality of the Board of Curators of the Royal College of Surgeons, and to the friendship of Mr. W. Clift, jun., for a beautiful drawing from a specimen in the Museum of the College, the only one I ever had an opportunity of examining. From that drawing the one now annexed is a close copy.

M. Temminck has described this bird in his *Histoire Naturelle Générale des Pigeons et des Gallinacés*, vol. ii. p. 448, under

under the name of *Peintade Cornal*, but does not mention the anatomical structure.

Dr. Parsons has given a representation of the trachea of the Demoiselle (*Ardea Virgo* of Linnæus) in the 56th volume of the *Philosophical Transactions*, from which Dr. Latham copied his figure: but as the true character of this trachea is less perfectly understood by a detached figure, and as this figure moreover is somewhat incorrect in the form of the bronchia, I have ventured to add a drawing of the sternum of this bird with its trachea *in situ*, the better to compare it with the structure of the same part in the very rare bird that will follow. In the present instance, the trachea, quitting the neck passes downward between the branches of the furcula toward the anterior edge of the keel, which is hollowed out to receive it; into this groove, formed by the separation of the sides of the keel, the trachea passes, and is firmly bound therein by cellular membrane. In the figure annexed, a small portion of one edge of the keel is removed, to show the depth of the insertion. The usual form of furcula does not prevail in this bird: it is not here, as in most others, a detached bone, but has the point of union of the two branches firmly ossified to the keel, or may be considered as a prolongation of the keel itself, extended to the head of each clavicle, and affording a firm support to the wing. The peculiar formation of the trachea, and its insertion within the keel of the sternum in this bird, may be considered as exhibiting the commencement of that structure, which, with some modification in a second species, is carried to its greatest extent in the Cranes.

One example only of the rare bird above mentioned appears to have been brought alive to this country; and this specimen will be found described and figured by Mr. Vigors in the second volume of the *Zoological Journal*, page 234, under the name of *Anthropoides Stanleyanus*. It is fortunate for science, that the
notice

notice of this new and interesting species should have been furnished by a gentleman so eminently distinguished for his acquirements as a naturalist and a scholar. Possessing as this bird does in a great degree the external characters of the Demoiselle, it also bears some resemblance to it in its anatomical structure. The trachea, quitting the direction of the vertebræ of the neck at the lower part, passes downward and backward between the branches of the furcula till it reaches the anterior edge of the keel ; it then turns upward into a groove formed for its reception, and being suddenly reflected forward and downward, traverses the projecting portion of the sternum, and passes backward to the lungs, as shown in the annexed representation. The furcula, it will be observed, is similar to that of the Demoiselle.

Dr. Latham's figure of the sternum and trachea of the Common Crane (*Ardea Grus*) being referred to, and compared with the same parts in the Demoiselle and the Stanley Crane, it will be perceived, that the insertion of the windpipe in the latter bird is upward, that of the Demoiselle principally backward, while that of the Common Crane will be found to be a compound of both, combining the upward inclination of the one with the backward insertion of the other ; and the depth of this insertion within the keel appears to depend on the age of the bird rather than the sex. In a very old female, of which I prepared the bones, the insertion is carried to the utmost extent that the size of the sternum will admit. In a second specimen of a younger male bird, the insertion was not so deep as in that last mentioned, but still much more so than in the sternum represented by Dr. Latham : and in the valuable and extensive collection of Joshua Brookes, Esq., to which that gentleman very kindly allows me access, there is a skeleton of the Common Crane,—evidently a young bird by the state of the bones,—in which the insertion is not carried so far as in the representation alluded to ;
but

but in a male and female of the same age, the greater depth of insertion may occur in the male, as stated in Dr. Latham's paper. The furcula and bronchia also of the Common Crane exactly resemble those of the Demoiselle and Stanley Crane, as might be expected in birds so nearly allied. Before quitting the subject of the *Anthropoides Stanleyanus*, it is necessary I should state, that this very rare bird passed when dead into the possession of Mr. Leadbeater, to whose liberality I am indebted for the opportunity afforded me of preparing and figuring part of the bones, and to whom I with pleasure acknowledge my obligations for many other interesting objects of investigation. The Indian Crane, *Ardea Antigone* of Linneus, has the same form of trachea and sternum as the Common Crane of Europe, *Ardea Grus*.

The Black Swan of New Holland, the *Anas Atrata* of Linneus and others, gives me an opportunity of showing a structure intermediate between the two most admired species of the genus *Cygnus* of Cuvier, the common mute Swan, the stately ornament of our lakes and rivers, and our more scarce winter visitor the Hooper.

In the Black Swan the trachea quits the neck at the bottom, and descends to the centre circular portion of the furcula, to which bone it is firmly bound by a tough membrane; the remaining portion then rises over the front of the breast bone between the clavicles, and passes backward to the lungs, the last portion of the tube immediately preceding the bone of divarication being flattened horizontally. The form of the trachea in our common Swan, in which it follows the neck without deviation, being remembered, and Dr. Latham's figure of the wild Swan referred to, it will be observed, that the Black Swan exhibits an interesting link between the two, and has not, that I am aware, been either described or figured.

The

Two opportunities having lately occurred to me of examining the structure of the Semipalmated Goose (*Anas semipalmata*) of Dr. Latham, who in his *Synopsis* and *General History* has given a figure of the bird and its trachea, I trust that the anatomical peculiarities I shall be able to exhibit as belonging to this bird beyond those already described, will be a sufficient reason for adding two representations of parts of both the birds above noticed, with some observations on each; premising, that the situation of the specimen referred to by Dr. Latham, that of a preparation in the collection of Mr. Heaviside, and the additional circumstance of two male birds of the same species presenting two decidedly different conformations of the same organ, will sufficiently account for the difference in the two statements.

TAB. XIII. is an exact representation of the form of the trachea in the first male of the two specimens I examined. It was situated on the outside of the left pectoral muscle, under the skin, and extended the whole length of the side, sufficiently raised under the wing that respiration would not be impeded when the bird rested with its breast on the ground; the parallel tubes being firmly attached both to the muscle and the skin by cellular tissue. These parallel tubes are placed in a more vertical position in the drawing than when attached to the bird, in order to bring the whole of them into view. The additional peculiarity of structure to be observed in this bird is the different formation of one clavicle as compared with the other. The clavicle on the right side of the bird is of the usual character; but that on the left is both shorter and wider, having an aperture about the middle, the sides diverging, with a projecting point on the inner side, to which the tube of the trachea is firmly attached about two inches above the bone of divarication. The trachea lying on the left side of the bird, the lower portion of the tube in its passage to the lungs crosses the left branch of the fur-

cula at a right angle; but becoming attached to this projection of the clavicle, receives from the point described its central direction into the body. The whole length of the windpipe in this bird is 4 feet 8 inches.

TAB. XIV. is a representation of the trachea of the second bird before referred to, and was also a male. It will be observed to want part of the interesting character of the first specimen, which the particular direction occupied by the leading portion of the tube in this second renders unnecessary: but the enlarged clavicle in this bird is on the right side, having a similar projection on its inner surface, forming a point of attachment for the tube, and performing the same office as in the other instance. It will remain for future investigation to show, whether in those male birds possessing the extra convolutions of the trachea, the enlarged clavicle is uniformly on the left side, and *vice versâ*. Four species of birds belonging to the Gallinaceous tribe have been figured by Dr. Latham as possessing convolutions of the trachea of various extent on the outside of the pectoral muscles: the same parts have also been represented on a larger scale by Mons. Temminck in his *Histoire Naturelle Générale des Pigeons et des Gallinacés*, and are described as possessing voices exceedingly harsh and loud. In this particular the Semipalmated Goose agrees perfectly; and in those species of Cranes and Swans already referred to, the power and depth of tone will be found to increase with the elongation of the tube.

Of the true physiology of these variations in form and lengthened convolutions little is known: that a connection exists between the sexual organs and those of the voice many proofs might be adduced; and it is not the least singular property of these singularly formed windpipes, that the more complicated the structure of the tube, the more disagreeable is the sound of the voice, the simple forms belonging to our most delightful song-birds.

The

The different species of Geese considered British, present nothing remarkable in their tracheæ, the Egyptian Goose alone excepted. The male of this bird possesses a bony enlargement at the bottom of its windpipe, in size equal to that marked (*a*) in TAB. XV. Systematic authors seem to agree in placing this bird at the bottom of the list of the Geese, where it appears to occupy its proper situation.

Combining as it does some of the characters common to those birds and the true Ducks, it becomes a very natural link between them; and with a few observations on an arrangement of the British species of the latter portion of this family, founded upon internal as well as external conformation, I shall close this paper.

The first division of true Ducks will contain the Shielduck, Muscovy, Wild Duck, Gadwall, Shoveler, Pintail, Wigeon, Bimaculated Duck, Garganey, and Teal,—all of which will be found to have the following characters in common. Externally they exhibit considerable length of neck: the wings are also long, reaching to the end of the tail; the tarsi somewhat round; the hind-toe free, or having no pendent lobe. In habits they may be stated generally as frequenting fresh-water, but passing much of their time on land, feeding in ditches and about the shallow edges of pools on aquatic plants, insects, worms, and occasionally fish, taking their food at or near the surface; possessing great powers of flight, but seldom diving, unless pursued. Of their internal soft parts, the stomach is in the greatest degree muscular, forming a true gizzard; the intestines long, the cæcal appendages from six to nine inches in length in the larger birds, and decreasing only in proportion to the size of the species. Of the bones it may be observed, that the ribs are short, extending but little beyond the line of the posterior edge of the sternum; the keel of the breast-bone deep, affording great ex-

tent of surface for the insertion of large and powerful pectoral muscles ; the enlargement at the bottom of the trachea in all of them is of bone only. The Wild Duck may be considered the type of this division.

The Eider Duck, King Duck, Velvet Duck, and Scoter, possessing some characters common to the preceding class, and others belonging to that next in succession, appear to supply the link between these two divisions. I regret that the extreme rarity of three of the species last named has hitherto prevented my obtaining any examination beyond that afforded by the external part of preserved specimens in collections ; and I am therefore unable to state their comparative structure.

The next division of true Ducks includes in the following order the Red-crested, the Pochard, Ferruginous, Scaup, Tufted, Harlequin, Long-tailed, and Golden Eye ; and their general distinctions, internal as well as external, compared with those of the birds of the first division, will be found of an opposite character. Externally they exhibit the neck and wings short, the latter only reaching to the origin of the tail-feathers ; the tarsi short and compressed ; the hind-toe lobated, and an extended web to the inner toe. They frequent the sea, or the deep parts of the largest fresh-water lakes, and have been called oceanic Ducks ; seldom seen on land ; their walk embarrassed from the backward position of the legs, but dive constantly and with great facility, taking their prey at various depths below the surface ; their food finned and shell-fish, marine insects, but little or no vegetable production ; their powers of flight moderate. Of their soft parts, the œsophagus is capable of great dilatation ; the stomach is a muscular gizzard ; but the internal cavity increases in size, those of the Long-tailed Duck and Golden Eye most resembling the stomach of the Mergansers ; the intestines and cæcal appendages are shorter,
the

the latter diminishing from six inches in the first to four and a half in the Tufted Duck, three inches in the Long-tailed, and but two in the Golden Eye. The ribs of the birds of this division are elongated; the keel of the breast-bone gradually decreases in depth; the position of the wings is more forward, the legs placed further back. The tracheæ of these Ducks are particularly distinguished from those of the others by the enlargement at the bottom of the tube being covered with a delicate membrane, supported by slender portions of bone; the trachea of the Red-crested Duck (TAB. XV. *e.*) is an example of this form, and may be considered the type of this division. As the Egyptian Goose has in this arrangement been considered the link between the Geese and the first division of the true Ducks, from its possessing, with the characters of the former, the bony enlargement of the trachea common to the latter; and the Velvet Duck, for similar reasons, supplying the link between the two divisions of true Ducks, possessing, among other characters, an altered form of the bony enlargement of the trachea of one, with the lobated toe of the other; so the Golden Eye, the last of the series, appears to complete the arrangement, by exhibiting some of the characters found in the Mergansers, which are next in succession. The first point of similarity is in the elongated feathers on the top of the head, forming a crest; they agree also in the shape of the sternum, and a particular extension of its posterior edge, becoming an ensiform process, the appearance of which in the Goosander is represented in TAB. XV. marked (*g*): and this extension of the edge of the breast-bone prevails in the species of the genera *Colymbus*, *Alca*, and *Uria*; and with the elongation of the ribs observable in all good salt-water Divers, seems intended as a protection to the important viscera of the abdomen, and enables them to resist pressure when below
the

the surface. In its stomach, intestines, and cæcal appendages, the Golden Eye is also intermediate, the latter being only two inches in length. In the Goosander these appendages are three inches; but the size of the bird being considered, reduces them on a comparative estimate to less than two: in the Red-breasted Merganser they are but one inch; the Smew is without any. In the form of its trachea, the Golden Eye more closely resembles the Mergansers than that of any other Duck, by the enlargement in the tube, and in the shape of the labyrinth, as a reference to Dr. Latham's representations will show. Thus the whole of the numerous species of the *Anatidæ* appear to descend to the more perfect water-birds by gradations, but with well-marked divisions throughout.

How far I am correct in an arrangement not strictly in accordance with the published systems of ornithologists, I must leave to better judges to determine; assuming, however, that an arrangement will be the more natural according to the proportion in which it combines ascertained habits, external characters, and anatomical structure*.

* The following extract is made from the 68th number of Mons. Temminck's *Planches Coloriées*, recently received in this country, Article 406.

HYDROBATES LOBATUS, Temm.

“ Nous avons cru nécessaire de separer des canards proprement dits, et de réunir sous la dénomination mentionnée, toutes ces espèces à doigt postérieur garni d'un rudiment de membrane, vu que le squelette de ces oiseaux nous offre des différences marquées et constantes; que leur manière de vivre et le choix des alimens ne sont pas les mêmes que chez les canards à doigt postérieur lisse, et que des caractères faciles à saisir fournissent de très-bons moyens pour établir la différence générique entre ces deux groupes. Nous renvoyons tous les détails sur l'organisation et les mœurs à l'article contenant les généralités et l'Index du genre *Hydrobate*.”

The description of the generic characters and other peculiarities has not yet appeared.

EXPLA-





